

**Fire Protection Assessment / Fire Hazard Analysis  
Brookhaven National Laboratory  
Building 729, NSLS Source Development Laboratory**

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Conferred with: E. Johnson, Senior Physicist - NSLS  
N. Gmur, Safety Coordinator - NSLS

**Purpose/Scope**

The purpose of this assessment is to evaluate the facility related fire protection aspects of Building 729 to ensure compliance with DOE fire protection criteria. DOE fire protection criteria are outlined in DOE Order 420.1<sup>1</sup>. A Fire Hazard Analysis, required for the Safety Analysis Document for this facility, is incorporated in this assessment.

**Summary**

The proposed use of the building, updated on April 23, 1997 and described under "Occupancy and Associated Fire Hazards", below, are based on a field survey, a review of the work proposal, and discussions with E. Johnson and N. Gmur. The level of fire protection in this building is sufficient to classify this building as an "improved risk", thereby meeting the objectives of DOE Order 420.1. No items exist for which improvement measures are recommended.

**Recommendations**

**1. Status of Recommendations from Previous Survey**

There are no recommendations from the previous survey.

**2. New Recommendations Resulting from the Current Survey**

FHA97-729-1 To the extent possible, the Class 4 laser installation and use in Bldg. 729 should comply with the recommended practices in NFPA 115, Laser Fire Protection.

FHA97-729-2 The oil coolant in the Klystrons should be tested to determine if the oil contains PCBs. If the results of these tests show a presence of PCBs in the oil coolant, the FHA will need to be

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<sup>1</sup>US Department of Energy Order No. 420.1, Facility Safety, 11/16/95

updated to reflect the increased loss potential due to the contamination hazards associated with fires involving PCBs.

## **Analysis**

### **1. Construction**

Building 729 is a one-story steel framed building with insulated metal panel walls and a standing seam metal roof deck on a poured concrete slab. The total building area is approximately 7600 sq. ft. The building is attached directly to the north side of existing Building 726.

Several 8 ft. high concrete shielding walls are to be constructed in the north section of Bldg. 729. The configuration of these shielding walls will vary over time based on several proposed experimental setups. Plans reviewed as part of this survey include two shield wall configurations and three different machine configurations. The proposed arrangements of the shielding walls are shown in Figures 1, 2, and 3 in Attachment A to this report. The shielding walls will house an electron gun and a linear accelerator with plans to possibly add a storage ring and two types of wigglers in the future. At the present time there are no plans to provide a roof over the shielding wall enclosure.

The mechanical equipment room in Building 729 is separated from the remainder of the building by one hour rated fire walls. There are no other fire rated interior walls. The control area for the accelerator is located on the general floor area of the building, with no fire separation (see Section 2.2.1 for details). A clean room that will house a laser system is located in the southeast section of Bldg. 729. The clean room is constructed of a 3 in. thick polystyrene core wall system covered with a vinyl covered hardboard (combustible construction).

#### **1.1 Fire Barrier Integrity**

There are no fire barriers required for Building 729. As indicated above, Building 729 is attached and open to Building 726. Therefore, the two buildings are considered to be a single fire area. Potential fire hazards in Building 726 which could affect the operations of the Source Development Laboratory in Building 729 are discussed in the appropriate sections below.

#### **1.2 Windstorm Damage Potential**

Due to the substantial metal panel construction, the windstorm damage potential at this facility is considered to be very slight.

### **2. Occupancy and Associated Fire Hazards**

The proposed occupancy of Building 729 is classified as industrial. The building is to be occupied by a Source Development Laboratory consisting of an electron gun, a linac, a transport line, and associated related equipment enclosed in concrete shielding walls. The remainder of the building is to be occupied by various electrical, electronic, and mechanical equipment to provide for operation and control of the Accelerator. There is also a mechanical equipment room located in a separate room in Building 729. Combustible loading within Building 729 is expected to be very light. Automatic sprinkler protection is provided throughout Building 729.

The clean room installed in the southeast section of Bldg. 729 is designed to house a Class 4 laser system. Class 4 lasers are considered to be beam ignition hazards. To the extent possible, the laser

installation and use should comply with the recommended practices in NFPA 115, Laser Fire Protection. In conjunction with this report, a copy of NFPA 115 has been forwarded to N. Gmur and E. Johnson (see Recommendation FHA97-729-1).

The scope of NFPA 318, Protection of Clean Rooms, is for semiconductor facilities containing clean rooms. The clean room in Bldg. 729 is not intended for semiconductor production and therefore was not designed to the requirements of NFPA 318. The clean room in Bldg. 729 was designed and installed as a combustible structure containing high value electronic equipment.

Building 726, which is attached to Building 729, will continue to be used as a light machine shop. The combustible loading in this area is considered to be light to moderate. Automatic sprinkler protection is provided throughout Building 726.

### 2.1 Critical Process Equipment

By DOE standards, critical process equipment is considered to be equipment which, if lost or damaged in a credible fire, could delay a significant component of a major program for a period in excess of 6 months.

By the above definition, the Accelerator and the associated equipment in Building 729 are not considered to be critical process equipment.

### 2.2 Special Occupancies

Special occupancies include electronic data processing and vital/important records. The special occupancies of Building 729 are expanded upon in sections 2.2.1 and 2.2.2, below.

#### 2.2.1 Electronic Data Processing

The control equipment associated with the operation of the Accelerator in Building 729 is to be located on the general floor area of the facility. This arrangement is acceptable since the control room equipment is not considered to be essential as defined by DOE/EP-0108, Standard for Fire Protection of DOE Electronic Computer/Data Processing Systems.

#### 2.2.2 Vital and Important Records Storage

Vital records are those records which are essential to the mission of an important program and which, if lost, could not be reproduced or obtained elsewhere. Important records are those records possessing a high value to the mission of an important program but which, if lost, could be reproduced or reconstructed with difficulty or extra expense.

Based on the above definition, there are no vital or important records associated with this program.

### 2.3 Unique Fire Hazards

Unique fire hazards include; modular buildings, trailers, cooling towers, flammable liquid & gas storage, cable trays, housekeeping in vital areas, and highly combustible building materials. The unique fire hazards of Building 729 (and Building 726) are expanded upon in sections 2.3.1 through 2.3.7, below.

#### 2.3.1 Modular Buildings

There are no modular buildings attached directly to Building 729. Modular Building 728, located 30 ft. to the west of Building 729 and Building 726, is not considered to be an exposure hazard (see Section 6 for details).

### 2.3.2 Trailers

There is a group of trailers located 25 ft. southeast of Building 729. These trailers, while having a moderate amount of combustible loading, are not considered to be an exposure hazard to Building 729 (see section 6 for details).

### 2.3.3 Cooling Towers

There are no cooling towers associated with Building 729. There is a large pad mounted chiller located approximately 10 ft. north of Building 729. The chiller is constructed of noncombustible materials.

### 2.3.4 Flammable Liquid & Gas Storage

The amount of flammable liquids to be stored in Building 729 and that which exists in Building 726 is minimal. Storage is generally restricted to a safety cabinet located adjacent to the mechanical equipment room in Building 729. Incidental use and storage outside of the flammable liquid storage cabinet does not exceed the quantities allowed by NFPA 30, Flammable and Combustible Liquids Code.

There are three Klystron/modulator Systems located in Building 729 and plans to add one additional unit in the future. Each system contains approximately 150 gallons of a Class IIIB (FP > 300 deg. F.) combustible oil coolant similar to transformer oil. The systems are provided with secondary containment. The automatic sprinkler protection provided in Building 729 is considered to provide adequate protection for this hazard.

Based on the age of the Klystrons, the oil coolant is believed to not contain PCBs. Testing of the oil is currently being pursued to verify this information. If the test results show PCBs in the oil coolant, the FHA will need to be updated to reflect the increased loss potential due to the contamination hazards associated with fires involving PCBs (see Recommendation FHA97-729-2).

There is no flammable gas cylinder storage at Building 729 or Building 726.

### 2.3.5 Cable Trays

High voltage, low voltage, control, and signaling cables are to be segregated in accordance with NEC requirements throughout Building 729. The cabling is to be located in conduits, raceways and cable trays. In most instances, the cables to be provided in the cable trays will meet the IEEE 383 flammability test criteria.

Automatic sprinkler protection is provided throughout Building 729, providing adequate protection for the proposed cable trays.

### 2.3.6 Housekeeping in Vital Areas

Housekeeping in Building 729 was not evaluated as the proposed facility was under renovation during this analysis.

Housekeeping in Building 726 is adequate to minimize potential fire hazards.

### 2.3.7 Highly Combustible Building Materials

No significant amounts of exposed polystyrene insulation or other highly combustible building materials are used in the construction or operations at Building 729. The clean room which houses the laser system is constructed of a 3 in. thick polystyrene core wall system covered with a vinyl covered hardboard (combustible construction). The clean room is provided with automatic sprinkler protection.

## 3. Fire Protection/Suppression Features

Manual fire alarm pull stations are installed at all egress doors throughout Building 729 and Building 726. Supervised fire alarm bells are located throughout the facility. Duct smoke detectors are provided on the air supply systems located in Building 726 and on both the supply and return air systems located in Building 729. In addition, spot type smoke detectors are located at the ceiling and below the raised floor of the Laser Room located in Bld.. 729.

Automatic heat detection is provided for the portable structure located east of Building 729.

Automatic sprinkler protection is provided throughout Building 729 including within the Laser Room in the southeast section of the building. This sprinkler system is designed to provide a minimum density of 0.15 gpm over the hydraulically most remote 2600 sq. ft. area. The water demand for this hydraulic design is 447 gpm @ 44 psi at the base of the riser. The water supply in the area of Building 729 is adequate to meet the required demand of this system including 250 gpm for hose streams. Two fire hose connections fed from the sprinkler system are located in Building 729.

Automatic sprinkler protection is also provided throughout Building 726. The sprinkler system is designed on an ordinary hazard pipe schedule system. It is estimated that the system is capable of providing an average density of 0.15 gpm over the hydraulically most remote 2500 sq. ft. area including 250 gpm for hose streams which is required for the existing occupancy.

The building fire alarm system is arranged to annunciate: locally, at BNL Fire/Rescue Headquarters (Building 599), and BNL Police Headquarters (Building 50).

An adequate number of properly rated hand-held fire extinguishers are located throughout this facility.

The fire protection/suppression features of vital programs, high valued property, and essential safety class systems at Building 729 are expanded upon in sections 3.1 through 3.3, below.

### 3.1 Fire Protection of Vital Programs

The operation associated with this facility is not considered to be a vital program. Therefore, no special fire protection precautions, beyond those that are described above, are required for this facility. As a general note, the fire protection features presently provided at this facility should prevent a credible fire from delaying this program in excess of six months.

### 3.2 Fire Protection of High Value Property

The Source Development Laboratory is considered to be high valued property. However, due to the noncombustible building construction, the relatively low combustible loading in the accelerator area, and the overall noncombustible construction of the Accelerator, a maximum possible fire would not be expected to cause 100% loss of the Accelerator. It is estimated that approximately 25% of the Accelerator's value could be lost or damaged in a maximum possible fire. While this value exceeds \$1 million, the fire protection features provided in Building 729 should limit this dollar loss expectancy to an acceptable level (under \$250,000).

### 3.3 Protection of Essential Safety Class Systems

There are no essential safety class systems associated with this non-nuclear facility.

## 4. Fire Loss Potentials

Fire loss potentials are classified into three major categories; the maximum credible fire loss, the maximum possible fire loss, and the recovery potential. The loss potentials for Building 729 are expanded upon in sections 4.1 through 4.3, below.

### 4.1 Maximum Credible Fire Loss (MCFL)

The Maximum Credible Fire Loss (MCFL) for any given area of Building 729 is expected to be less than \$250,000. Typical areas where a loss of this magnitude could be expected to occur include; cable trays in the vicinity of the Accelerator and/or electron gun, electronic control equipment for the accelerator, and oil filled Klystron/modulator Systems on the general floor area. The fire protection features at this facility are sufficient to restrict the estimated MCFL to within acceptable loss limitations specified by DOE.

### 4.2 Maximum Possible Fire Loss (MPFL)

The Maximum Possible Fire Loss (MPFL) for this facility is estimated to be the result of an uncontrolled fire in the general building area which would involve the coolant oil in the Klystron/modulator Systems. Assuming a 25% loss and/or damage to the building and a 25% loss and/or damage to the building contents, including the Accelerator and associated equipment and extensive damage to the associated cabling, a loss in excess of \$2 million could be anticipated.

The fire protection features presently provided for the facility should prevent a MPFL of this nature from occurring in Building 729.

The MPFL for this facility resulting from an uncontrolled fire originating in Building 726 is estimated to be in excess of \$1 million due to the smoke damage potential that could occur to the Accelerator equipment in the Building 729. Again, the fire protection features provided at the facility should prevent a MPFL of this nature from occurring in Building 726 and Building 729.

### 4.3 Recovery Potential

It is unforeseeable that a credible fire in Building 729 or Building 726 would result in a shutdown of the Accelerator for an excessive period of time (greater than 6 months).

#### 5. Security Considerations Related to Fire Protection

There are no security considerations which relate to fire protection at this facility.

#### 6. Exposure Fire Potential

Exposure fire potential at Building 729 is limited to the possible exposure from Building 727, Building 728, portable trailers southeast of the building, and a 1500 kVA transformer yard. The space separations and other relevant factors of these exposures are discussed below. There are no additional fire exposures beyond those noted above.

There is a 20 ft. separation between Building 729 and Building 727. Building 727 is a fully sprinklered metal panel building with light combustible loading. Based on this information, Building 727 is not considered an exposure hazard to Building 729.

There is a 30 ft. separation between Building 729 and Building 728. Building 728 is an unsprinklered modular office building of wood construction, having a total floor area of 3600 sq. ft. Based on this information, Building 728 is not considered an exposure hazard to Building 729.

There is a total of 17 nonsprinklered trailers and portable structures subdivided into 2 separate "fire areas" located 40 ft. east of Building 729. The trailers and portable structures are a combination of combustible and noncombustible construction. The trailers are used for cold storage by the NSLS department. Overall combustible loading of these trailers is considered to be light to moderate. Based on this information, the trailers and portable structures are not considered to be an exposure hazard to Building 729.

A 1500 kVA oil filled transformer, with adequate containment curbing, is located approximately 50 ft. north of Building 729. Based on Factory Mutual Data Sheet 5-4, the transformer is not considered an exposure hazard to Building 729.

#### 7. Environmental Impact due to a Fire (Including Water Runoff)

Toxic, biological, and radiation incidents resulting from a fire, including water runoff, could have an impact on the environment. The potential for these incidents occurring at Building 729 are expanded upon in sections 7.1 through 7.3, below.

##### 7.1 Toxic Incident

There are no known materials in Building 729 that, if involved in a fire, would result in a significant quantity of toxic material being created and released.

##### 7.2 Biological Incident

Due to the lack of biological matter at this facility, an incident of this type is unforeseeable.

### 7.3 Radiation Incident

No radioactive materials are used or stored in Building 729. By the nature of the operations of the accelerator, various pieces of equipment can be expected to become activated. This activation is not expected to pose a significant environmental impact in the event of a fire.

## 8. Prefire and Emergency Planning

The BNL Fire Department maintains an adequate prefire plan book for this facility. A local emergency plan is maintained by the NSLS department.

### 8.1 Fire Apparatus Accessibility

Fire apparatus accessibility is adequate at this facility.

## 9. Life Safety Considerations

Major life safety considerations for this industrial facility include the following components; means of egress components and capacity, number and arrangement of the means of egress, travel distances to exits, discharge from the exits, and emergency lighting and marking of the means of egress.

At Building 729, all of the above components are in accordance with the requirements of NFPA 101-94, The Life Safety Code.

To accommodate the installation of the clean room, an exit door on the east end of Building 729 was permanently removed from service. The removal of this exit door does not affect the facilities compliance with the Life Safety Code.



## **Appendix A**

### **Blind Recommendations**

This appendix provides documentation for recommendations which are in the best interest of fire prevention but for which corrective action is not considered to be cost beneficial.

There are no blind recommendations as a result of this survey.

**Attachment A**

**Proposed Facility Layouts**

(See Figures 1, 2, and 3)





